Instructions: Complete each of the following exercises.

Motion in Space

1. Find the velocity, acceleration, and speed of a particle with the given position function.

   (a) $\mathbf{r}(t) = \langle t^2 + t, t^2 - t, t^3 \rangle$

   (b) $\mathbf{r}(t) = \langle \sqrt{2}t, e^t, e^{-t} \rangle$

   (c) $\mathbf{r}(t) = 3\cos(t)\mathbf{i} + 2\sin(t)\mathbf{j}$

   (d) $\mathbf{r}(t) = \langle t, 2\cos(t), \sin(t) \rangle$

   (e) $\mathbf{r}(t) = \langle t, t^2, t^3 \rangle$

   (f) $\mathbf{r}(t) = t\mathbf{i} + t^2\mathbf{j} + 2\mathbf{k}$

2. When is the speed of a particle with position function $\mathbf{r}(t) = \langle t^2, 5t, t^2 - 16t \rangle$ minimized?

3. A projectile is fired with initial speed 200 m/s and angle of elevation 60°. Compute the range of the projectile, the maximum height reached, and the speed on impact with the ground.

4. A ball is thrown at an angle of 45° to the ground and lands 90 m away. What is the initial speed of the ball?